

# VXI

## **VXI-MXI-Express Series User Manual**

*NI PCIe-8361, NI PCIe-8362, NI ExpressCard-8360, and NI VXI-8360T*

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All Class A products display a simple warning statement of one paragraph in length regarding interference and undesired operation. The FCC rules have restrictions regarding the locations where FCC Class A products can be operated.

Consult the FCC Web site at [www.fcc.gov](http://www.fcc.gov) for more information.

### FCC/DOC Warnings

This equipment generates and uses radio frequency energy and, if not installed and used in strict accordance with the instructions in this manual and the CE marking Declaration of Conformity\*, may cause interference to radio and television reception. Classification requirements are the same for the Federal Communications Commission (FCC) and the Canadian Department of Communications (DOC).

Changes or modifications not expressly approved by NI could void the user's authority to operate the equipment under the FCC Rules.

### Class A

#### Federal Communications Commission

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user is required to correct the interference at their own expense.

#### Canadian Department of Communications

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Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

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\* The CE marking Declaration of Conformity contains important supplementary information and instructions for the user or installer.

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# About This Manual

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This manual contains instructions for installing and configuring the VXI-MXI-Express series controller interface kit. It also discusses how to start developing your VXI/VME application.

## Conventions

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The following conventions appear in this manual:

»

The » symbol leads you through nested menu items and dialog box options to a final action. The sequence **File»Page Setup»Options** directs you to pull down the **File** menu, select the **Page Setup** item, and select **Options** from the last dialog box.



This icon denotes a note, which alerts you to important information.



This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash. When this symbol is marked on a product, refer to the [Safety](#) section in Appendix A, [Specifications](#), for information about precautions to take.

**bold**

Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

*italic*

Italic text denotes variables, emphasis, a cross-reference, or an introduction to a key concept. Italic text also denotes text that is a placeholder for a word or value that you must supply.

`monospace`

Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames, and extensions.

`monospace italic`

Italic text in this font denotes text that is a placeholder for a word or value that you must supply.

VXI-MXI-Express  
Series controller

This term implies any of the VXI-MXI-Express Series controllers, such as the NI VXI-8360T.

x1 MXI-Express  
host adapter

This term implies any of the x1 MXI-Express host adapters, such as the NI PCIe-8361, NI PCIe-8362, and NI ExpressCard-8360.

## Related Documentation

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The following documents contain information that you might find helpful as you read this manual:

- Your computer and/or chassis documentation
- *PCI Express Specification, Revision 1.0a*
- *NI ExpressCard MXI Series User Manual*
- *MXI-Express (x1) for PXI Express Series User Manual*
- ANSI/IEEE Standard 1014-1987, *IEEE Standard for a Versatile Backplane Bus: VMEbus*
- ANSI/IEEE Standard 1155-1998, *IEEE VMEbus Extensions for Instrumentation: VXIbus*
- ANSI/VITA 1-1994, *VME64*
- *VXI-6, VXIbus Mainframe Extender Specification, Rev. 2.0, VXIbus Consortium*
- *NI-VISA Help*
- *NI-VXI Help*
- *Measurement & Automation Explorer Help for NI-VISA/NI-VXI*



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# Introduction

This chapter describes your VXI-MXI-Express Series controller interface kit, lists what you need to get started, and includes a brief description of the hardware and software.

The VXI-MXI-Express Series controller interface kits link a PCI Express-based host computer to the VXIbus using the National Instruments MXI-Express (x1) interface. These kits make your computer perform as though it were plugged directly into the VXI backplane, giving it the capabilities of an embedded computer.

The National Instruments VXI-MXI-Express Series controllers include the NI VXI-8360T and any kit containing the NI VXI-8360T. The controllers are C-sized VXI modules which plug into your VXI mainframe. The VXI-8360T incorporates functionality allowing the extension of the 8 TTL backplane triggers and CLK10 between multiple chassis through convenient front panel connectors.

Several different MXI-Express (x1) interfaces are available with the VXI-MXI-Express Series controller.

- NI PCIe-8361 is a single port (x1) PCI Express to MXI-Express interface board. This board plugs into an available PCI Express slot in the host computer.
- NI PCIe-8362 is a two port (x1) PCI Express to MXI-Express interface board. This board plugs into an available PCI Express slot in the host computer.
- NI ExpressCard-8360 is a (x1) ExpressCard/34 MXI-Express interface module that will work in both an ExpressCard/34 and ExpressCard/54 slot. With the ExpressCard interface, hybrid VXI systems can be built using National Instruments PXI and PXIe-based host computers. The NI ExpressCard-8360 can also be used to bring mobile/laptop control to the VXI system.

Kits that include a MXI-Express interface board also include a 3 m (x1) MXI-Express cable. 1 m and 7 m cables are also available and can be purchased separately.

The kits also include the NI-VXI/NI-VISA bus interface software, which is fully *VXIplug&play*-compliant. NI-VXI/NI-VISA is the National Instruments implementation of the VISA I/O software standard on which all *VXIplug&play* software components are based.

## What You Need to Get Started

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To set up and use the VXI-MXI-Express Series controller interface kit, you need the following items:

- A host computer with an available PCI Express slot<sup>1</sup> running the Windows XP operating system
- A PCI Express or ExpressCard to MXI-Express interface card
- A VXIbus mainframe
- A VXI-MXI-Express Series controller
- A x1 MXI-Express cable
- The National Instruments NI-VXI driver software CD
- This manual

## Hardware Description

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The VXI-MXI-Express Series controller is a C-size VXIbus Slot 0-capable device that can reside in slot 0 of any C-size or D-size chassis.



**Note** D-size VXI mainframes have connections for a P3 connector. The VXI-MXI-Express Series controller, however, does not have this connector and cannot provide the necessary control for VXI devices that need P3 support.

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<sup>1</sup> Some x16 slots may not work correctly with MXI-Express adapters.

# VXI-MXI-Express Front Panel Features

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The VXI-MXI-Express Series controller has the following front panel features:

- Eight front panel LEDs
  - **FAILED**—Indicates the VXI-MXI-Express Series controller failed power on diagnostics.
  - **SYSFAIL**—Indicates the VMEbus SYSFAIL line has been asserted on the backplane.
  - **ONLINE** —Indicates the board is detected and ready for use.
  - **ACCESS**—Indicates a VXI bus master is accessing the VXI-MXI-Express Series controller.
  - **CB**—Indicates the circuit breaker has tripped from an over current condition on the +5.0 V<sub>DC</sub> rail of the VXI-MXI-Express Series controller.
  - **ACT**—Indicates bus activity on the MXI-Express link.
  - **PWRGD**—Indicates the on board power supplies are in regulation.
  - **LINK**—Indicates the MXI-Express link connecting the host computer to the VXI-MXI-Express Series controller has been established.
- Three front panel SMB connectors for:
  - Trigger input
  - Trigger output
  - CLK10 I/O
- One x1 MXI-Express connector
- **TRIG/CLK PORT A(B)**—These ports allow the user to daisy chain the eight TTL backplane triggers and/or CLK10 between multiple chassis.
- **CABLE STATUS LED**

Off	Indicates no cables are connected to the TRIG/CLK PORT A(B) ports.
Blinking Red	Indicates the cables are connected incorrectly to the TRIG/CLK PORT A(B) ports.
Solid Green	Indicates the cables are connected correctly to the TRIG/CLK PORT A(B) ports.

## Advanced Configuration Options

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The VXI-MXI-Express default hardware configuration should be acceptable for most systems. Refer to Appendix B, *Default Settings*, only if your system uses the front-panel CLK10 and trigger SMB connectors.

The NI-VISA/NI-VXI bus interface software includes a Resource Manager, an interactive configuration and troubleshooting program, a comprehensive library of software routines for VXI/VME programming, a logging utility you can use for debugging, and graphical interactive control programs for interacting with VISA. You can use this software to seamlessly program multiple-mainframe configurations and have software compatibility across a variety of controller platforms.

NI-VISA has a comprehensive library of software routines not only for VXI/VME programming, but also for GPIB, GPIB-VXI, PXI, TCP/IP, and Serial. You can use this software to program instruments connected through different types of interfaces.

Measurement & Automation Explorer (MAX) helps you view your entire test and measurement system and configure various components, whether they are VXI, GPIB, PXI, or Serial devices. You can easily add VME devices to your system with MAX and view them in the configuration tree along with the rest of your system. MAX features various options for running the Resource Manager, Resman, such as performing resource manager operations on your VXI systems and configuring Resman to run automatically at startup. You also can execute Resman independently to configure your instruments after each power cycle.

The NI Spy utility tracks the calls your application makes to National Instruments drivers, including NI-VXI, NI-VISA, and NI-488.2. NI Spy helps you debug your application by clearly highlighting the functions that return errors. You can let NI Spy keep a log of your program's calls to these drivers so that you can check them for errors at your convenience.

## National Instruments Application Software

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In addition to the NI-VISA/NI-VXI software, you can use the National Instruments LabVIEW, Measurement Studio, and LabWindows™/CVI™ application programs and instrument drivers to ease your programming task. These standardized programs match the modular virtual instrument capability of VXI and can reduce your VXI/VME software development time. These programs are fully *VXIplug&play* compliant and feature

extensive libraries of VXI instrument drivers written to take full advantage of direct VXI control. LabVIEW, Measurement Studio, and LabWindows/CVI include all the tools needed for instrument control, data acquisition, analysis, and presentation.

LabVIEW is an easy-to-use, graphical programming environment you can use to acquire data from thousands of different instruments, including IEEE 488.2 devices, VXI devices, serial devices, PLCs, and plug-in data acquisition boards. After you have acquired raw data, you can convert it into meaningful results using the powerful data analysis routines in LabVIEW. LabVIEW also comes with hundreds of instrument drivers, which dramatically reduce software development time, because you do not need to spend time programming the low-level control of each instrument.

Measurement Studio allows you to choose from standard environments such as Microsoft Visual Basic, Visual C++, and Visual Studio .NET to create your application, using tools specific for each language. With Measurement Studio, you can write programs quickly and easily and modify them as your needs change.

LabWindows/CVI is an interactive ANSI C programming environment designed for building virtual instrument applications. LabWindows/CVI delivers a drag-and-drop editor for building user interfaces, a complete ANSI C environment for building your test program logic, and a collection of automated code generation tools, as well as utilities for building automated test systems, monitoring applications, or laboratory experiments.

To use any of these application programs, install them before installing the NI-VISA/NI-VXI software. LabVIEW, Measurement Studio, and LabWindows/CVI integrate the VXI and VISA libraries required to support your VXI-MXI-Express. You also get hundreds of complete instrument drivers, which are modular, source-code programs that handle the communication with your instrument to speed your application development.

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# Installation and Configuration

This chapter explains how to set up your test system.

## Installing the Software

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Use the Setup program that came with your NI-VXI/NI-VISA software to install the entire software package or a software update, or to reinstall software in the event that your files were accidentally erased. Some of the utilities rely on the LabWindows/CVI Run-Time Engine. This software is installed, if necessary, during the NI-VXI/NI-VISA installation.

Depending on the type of installation you choose, you may need up to 500 MB of free space on your hard drive to accommodate the NI-VXI and NI-VISA software.

To be compliant with *VXIplug&play* specifications, a VXI controller must provide the VISA I/O driver library standardized by *VXIplug&play*. VISA ensures that your controller can run all *VXIplug&play*-compatible software now and in the future.

The NI-VISA software in this kit is compatible with the WINNT/GWINNT framework. With NI-VISA installed on your computer, you can run any *VXIplug&play* software that is compatible with this framework. This includes instrument drivers and executable soft front panel software included with *VXIplug&play*-compatible instruments from a variety of vendors.

## Installing the NI-VXI and NI-VISA Software

This section describes how to install the NI-VXI and NI-VISA software.

Carefully read these directions along with any messages on the screen before making your selections. You can quit the Setup program at any time by clicking the **Cancel** button.



**Caution** To keep the manufacturer/model name tables or the VME device configuration from a previous installation, be sure to back them up before starting Setup. They are in the TBL subdirectory of your NI-VXI directory, usually Program Files\National Instruments\VXI.

Setup is an interactive, self-guiding program that installs the NI-VXI and NI-VISA software and configures your system to use the software with the VXI-MXI-Express. Complete the following steps to perform the installation.

1. Insert the CD. When prompted, select Install NI-VXI from the menu.  
If no menu appears when the CD is inserted:
  - a. Select **Start>Run** and enter the following text, where *x* is your CD drive (usually D):  
`X:\setup.exe`
  - b. Click the **OK** button to begin installing NI-VXI.
2. Click the **Next** button at the Welcome screen to start the installation and accept the license agreement.



**Note** If you have a previous version of the NI-VXI software installed, Setup installs the new version over the previous version.

3. Select the installation features from the **Features** screen.
  - For more information about the NI-VXI API, refer to Chapter 3, [Developing Your Application](#).
4. Click the **Next** button. After reading the license agreement(s), confirm your acceptance.
5. Click the **Next** button. Confirm that you are ready to install and click **Next** again to begin the installation.
6. Setup now copies the necessary files to your hard drive and creates program icons.

## Completing the Software Installation

Review the information in any README files that Setup prompts you to read.

When the installation process completes, reboot the system for the changes to take effect. If you backed up the manufacturer and model name files, restore them to the TBL subdirectory of your NI-VXI directory before running MAX.



**Note** If you save and restore the TBL files from an older version of NI-VXI, the software will use TBL files that do not have the latest updates from National Instruments and may not include recent hardware releases. If you added additional manufacturer or model names to your TBL files, we recommend merging those changes with the latest updates included with this version of NI-VXI, so that all your devices are properly identified.

## Configuring the Hardware (Optional)

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This section contains basic information about configuring your VXI-MXI-Express Series controller hardware. Because the default settings for your VXI-MXI-Express Series controller hardware are acceptable for most typical applications, this section is optional.

Refer to Appendix B, *Default Settings*, for a complete listing of the hardware and software default settings.

Use Measurement & Automation Explorer (MAX) to change any VXI-MXI-Express Series controller configuration settings.

For information about the software, including optional settings, use MAX and its online help. Use the Windows Start menu to open the program group for National Instruments, launch MAX, and select **Help»Help Topics**.

## Installing the Hardware

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This section summarizes how to install your VXI-MXI-Express Series controller hardware.



**Caution** To guard against electrostatic discharge, touch the antistatic plastic packages to a metal part of your computer or chassis before removing the boards from their packages. Your computer or chassis should be plugged in but powered off.

## Installing Your VXI-MXI-Express Series Controller



**Note** Although the VXI-MXI-Express Series controllers are typically installed in Slot 0 of the VXI chassis, they may operate in other slots of the chassis. If you choose to install the controller in a slot other than Slot 0, the automatic detection circuitry on the controller will detect the slot and configure the controller appropriately, if the J2 jumper is set to Auto-detect.





**Cautions** Having more than one device configured as system controller can damage the VXI system. For VXI systems that include VME devices, ensure that the VME devices are not configured in the upper 16 KB (starting from 0xC000) of the A16 address space. This region is reserved for VXI device configuration registers, which are used for initializing, configuring, and interacting with VXI devices. The VXI-MXI-Express Series controller also uses this region for this purpose.

Also ensure that no other VXI devices in your system are manually configured for the same logical address as your controller. The default shipping configuration is that the card auto-detects if it is in Slot 0.

To install the VXI-MXI-Express Series controller in Slot 0 of your VXI chassis, complete the following steps.

1. Power off the chassis.
2. Verify that the backplane connector is intact and that there are no bent or missing pins on the controller.
3. Insert the VXI-MXI-Express Series controller into the chassis in Slot 0, as shown in Figure 2-2.
4. Firmly press the VXI-MXI-Express Series controller into the mating connectors to ensure the module is fully inserted and seated in the connector.
5. Tighten the two ejector handle screws.
6. Power on the chassis.

The VXI system controllers operate certain VXI lines as required for VXI systems. Verify that any other VXI devices with system controller capability that are in the same chassis are not configured as system controller.

## Installing Your NI PCIe-8361/NI PCIe-8362 x1 PCI Express to MXI-Express Interface Card

To install your NI PCIe-8361/NI PCIe-8362 x1 PCI Express to MXI-Express module, complete the following steps.

1. Power off your computer, but leave it plugged in while installing the NI PCIe-8361/NI PCIe-8362. The power cord grounds the chassis and protects it from electrical damage while you install the card.



**Caution** To protect both yourself and the computer from electrical hazards, your computer should remain off until you finish installing the NI PCIe-8361/NI PCIe-8362.

2. Open the host computer or remove the top cover to gain access to the host computer PCIe expansion slots.
3. Select any available PCI Express expansion slot.



**Note** The BIOS or motherboard may not support the NI PCIe-8361/NI PCIe-8362 in a slot intended for a graphics card.

4. Locate the slot. Remove any slot and back panel covers and hardware (for example, screws).
5. Touch the metal part of the power supply case inside the computer to discharge any static electricity that might be on your clothes or body.
6. Line up the NI PCIe-8361/NI PCIe-8362 with the slot on the back panel. Slowly push down on the top of the NI PCIe-8361/NI PCIe-8362 until its card-edge connector is resting on the expansion slot receptacle. Using slow, evenly distributed pressure, press the NI PCIe-8361/NI PCIe-8362 straight down until it seats completely in the expansion slot, as shown in Figure 2-1.
7. Reinstall the bracket-retaining mechanism to secure the NI PCIe-8361/NI PCIe-8362 to the back panel rail.
8. Replace the computer cover.

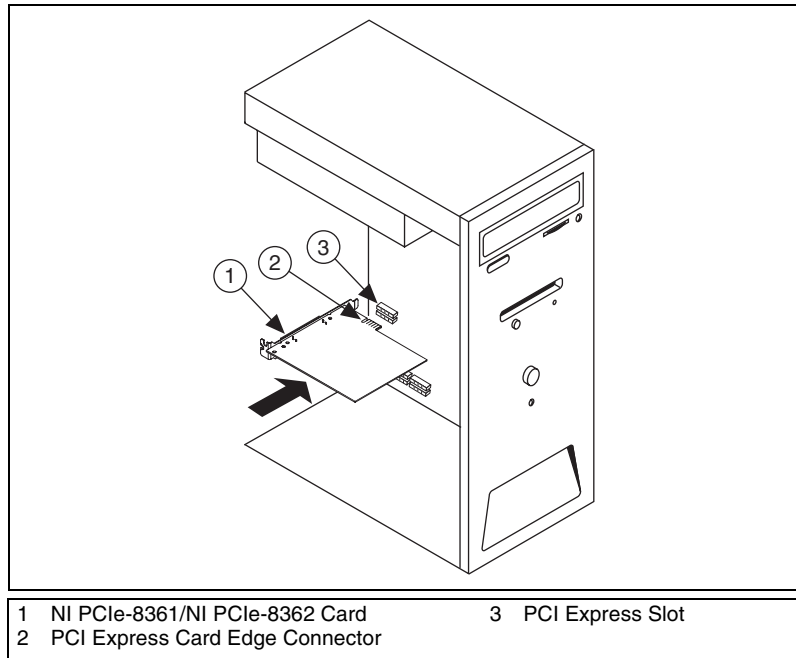


Figure 2-1. Installing the NI PCIe-8361/NI PCIe-8362

## Installing Your NI ExpressCard-8360 ExpressCard MXI Interface

Complete the following steps to install the ExpressCard interface card.

1. Power off your computer.



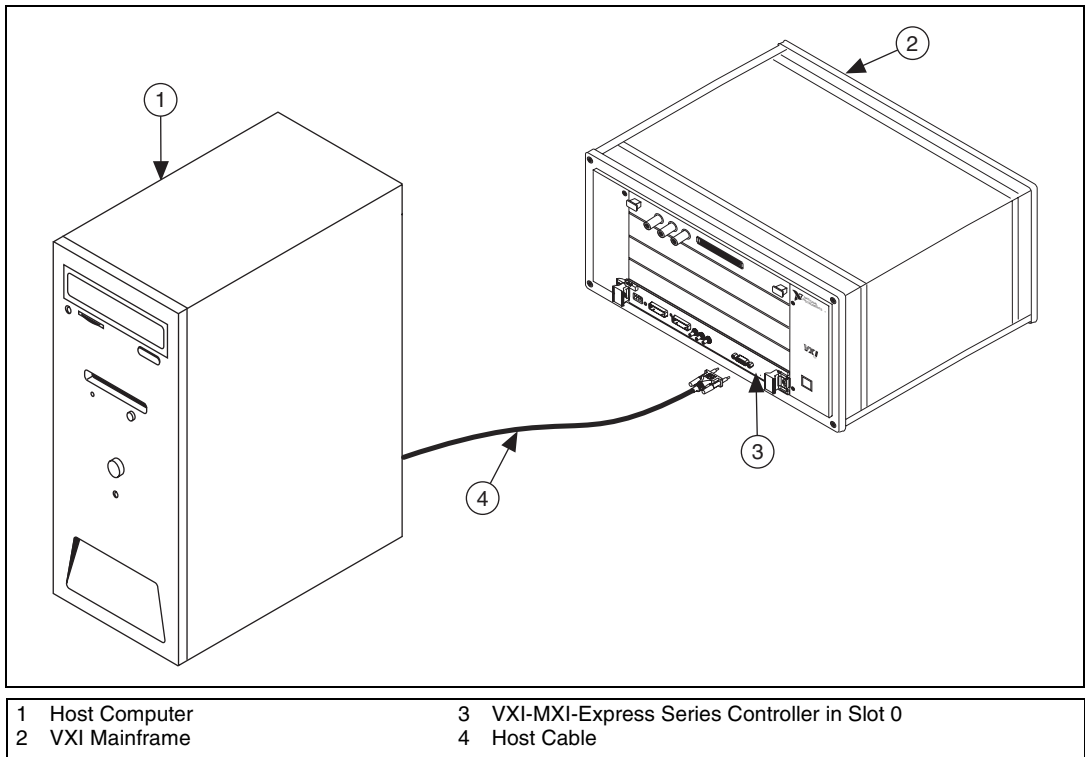
**Note** You may want to connect one end of the x1 MXI-Express cable to the ExpressCard-8360 prior to installing it into the host computer.

2. Insert the ExpressCard-8360 in any available ExpressCard/34 or ExpressCard/54 slot.

## Connecting Cables

Connect the x1 MXI-Express cable to the VXI-MXI-Express Series controller and then to the x1 MXI-Express host adapter in the host computer.

Figure 2-2 shows a system that includes a PCI Express-based host computer and a VXI-MXI-Express Series controller.



**Figure 2-2.** Host System with VXI-MXI-Express Series Controller

For information on connecting cables to TRIG/CLK PORT A(B) on the NI VXI-8360T, refer to the [Connecting the Trigger Port Cables](#) section of Appendix D, [Using The Trigger Ports On The VXI-8360T](#).

## Powering Up the MXI-Express System

Complete the following steps to power up the system.



**Note** All VXI expansion chassis must be fully powered before turning on the host computer, otherwise the expansion chassis will not be detected by the host.

There are no requirements on how VXI-MXI-Express-based expansion chassis are powered up relative to each other as long as they are all on before the host computer is powered on.

1. Power on all of the VXI expansion chassis in any order you choose.
2. Power on the host computer.

## Powering Down the MXI-Express System

Because operating systems and drivers commonly make the assumption that PCI devices will be present in the system from power-up to power-down, it is important not to power off the expansion chassis until after the host PC is powered off. Powering off the expansion chassis while the host is still on can cause crashes or hangs. The order in which expansion chassis are powered off, relative to each other, is not important.

## Software Configuration and Verification

---

Complete the following steps to configure the software and verify the configuration.

1. Run MAX. You must run the Resource Manager (Resman) every time the chassis or computer power is cycled, so that your application can access devices in the VXI chassis. You can also configure MAX to run Resman automatically at every computer startup by selecting **Tools»NI-VXI»VXI Options** from the menu and selecting the appropriate checkbox.
2. You can also use MAX to interactively configure the National Instruments hardware in your system. Use the right-click help for information about the various configuration options. After you finish configuring the system through MAX, verify the configuration through the interactive control utility, VISAIC (**Start»Programs»National Instruments»VISA»VISA Interactive Control**), as described in Chapter 3, *Developing Your Application*.



**Note** If you are using extenders such as MXI-2 to create a multichassis system, you may need to run Resman before configuring some of your devices.

---

# Developing Your Application

This chapter discusses the software utilities you can use to start developing applications that use NI-VXI.

After installing the NI-VXI software, you can begin developing your VXI/VME application. Be sure to check the release notes for the latest application development notes and changes.

---

## NI-VXI, NI-VISA, and Related Terms

---

Before you develop your application, it is important to understand the difference between NI-VXI, NI-VISA, and similar terms.

- *NI-VXI* is the software package that ships with National Instruments VXI and VME controllers. NI-VXI includes Measurement & Automation Explorer (MAX), NI-VISA, NI Spy, Resource Manager (Resman), VXI device drivers, and other utilities for configuring and controlling your VXI or VME system.
- *NI-VISA* is the native API for communicating with VXI/VME devices. NI-VISA is the National Instruments implementation of the VISA I/O standard, which is a common interface to many types of instruments (such as VXI, GPIB, PXI, Serial, TCP/IP, and so on). NI-VXI is optimized for use through NI-VISA, and NI recommends using NI-VISA to develop all new VXI/VME applications.
- The *NI-VXI API* is an optional development environment that is not part of the default NI-VXI installation. The NI-VXI API was developed before NI-VISA; although NI-VXI still supports the NI-VXI API, NI recommends using NI-VISA for all new VXI/VME applications. If you must develop an application using the older NI-VXI API, run the NI-VXI installer and enable **NI-VXI API Development**. Be sure to review the [NI-VXI API Notes](#) section.
- The *NI-VXI compatibility layer* allows older programs that use the NI-VXI API to communicate with VXI devices through VISA. Using this compatibility layer, older programs can run in NI-VXI 3.0 or later without being rewritten to use the VISA interface. This layer installs with NI-VXI by default. It should be completely transparent and

provide a high level of performance; however, there may be some slight changes in behavior for certain applications.

Your software features several system development utilities including MAX, Resman, NI Spy, VISA Interactive Control (VISAIC), and optionally VXI Interactive Control (VIC). You can also access online help and a variety of examples to learn how to use NI-VXI for certain tasks. Each component assists you with one of four development steps: configuration, device interaction, programming, and debugging.

You can access the utilities, help files, and release notes through the Windows **Start** menu by opening the **National Instruments»VXI** or **National Instruments»VISA** program groups.

## Configuration

---

The configuration utilities in your software kit are Resource Manager (Resman) and Measurement & Automation Explorer (MAX). Resman performs VXI Resource Manager functions as described in the VXIbus specification. Resman configures all devices on the VXI backplane for operation and allocates memory for devices that request it. Resman does not require you to specify any settings; it automatically performs the VXI resource management whenever you run it.

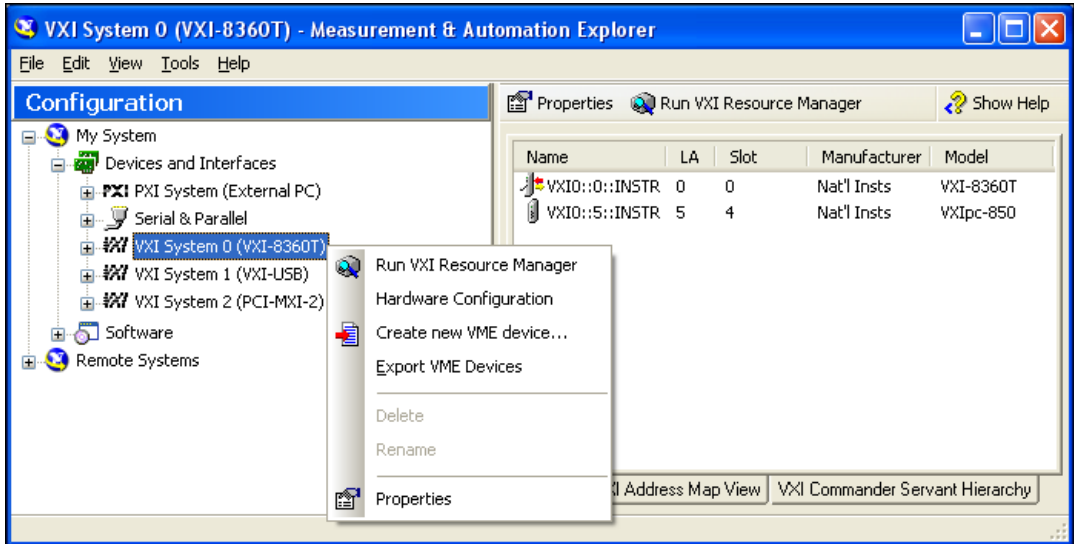


**Note** Power cycling resets all devices, so you must run Resman to reconfigure your system every time you cycle the power on the chassis.

MAX presents a graphical display of your entire test and measurement system to help you configure various components. When you launch MAX, you see all your devices (including VXI) on the screen. You can view the properties (such as logical address and address space) of each device by clicking the device in the configuration tree. To see additional configuration options for a given device, right-click the device in the configuration tree. When you access the properties of most National Instruments devices by right-clicking, you can configure the hardware settings by selecting **Hardware Configuration**.

MAX and Resman are designed to work together. You can run Resman through MAX by either clicking the Run VXI Resource Manager button in the toolbar or right-clicking a specific VXI system on which to run Resman, as shown in Figure 3-1. You can also select **Tools»NI-VXI»VXI Resource Manager** to run Resman on all VXI systems. From the VXI Options dialog box in the **Tools»NI-VXI** menu, you can also use MAX to configure

Resman to run on all VXI systems automatically when the computer boots. Resman reports to MAX all errors it finds in your system. When you view your VXI system in MAX, you can easily spot any errors that Resman found while configuring the system.



**Figure 3-1.** Right-Click a VXI System in MAX to Run Resman on that System

After Resman detects and configures all your VXI/VME devices, you can use MAX to view specific information about each device in your system. The default MAX view of a VXI system shows the General tab window, which contains a summary of key information about each device, including its device name, logical address, model name, and other data. For more information about MAX, refer to its online help by selecting the **Help»Help Topics** menu.

## Device Interaction

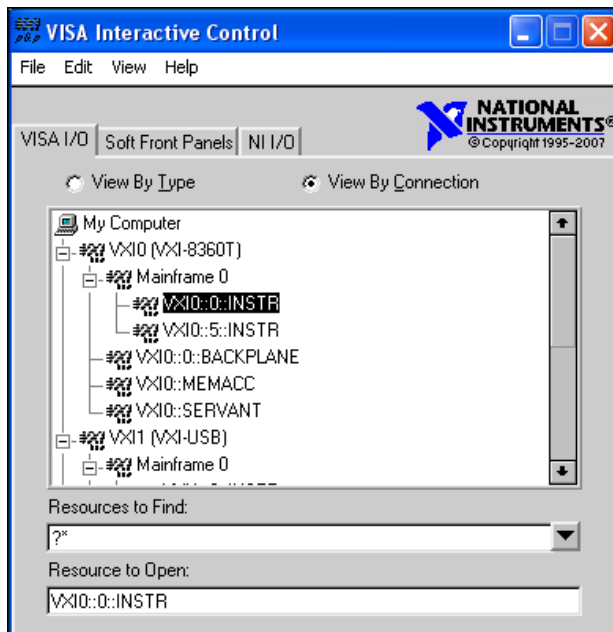
You can interact with your VXI/VME devices using the VISA Interactive Control (VISAIC) utility. VISAIC allows you to control your VXI/VME devices without using LabVIEW, Measurement Studio, LabWindows/CVI, or another programming language. You can also control your devices in MAX by right-clicking a device name and selecting **Open VISA Session**.





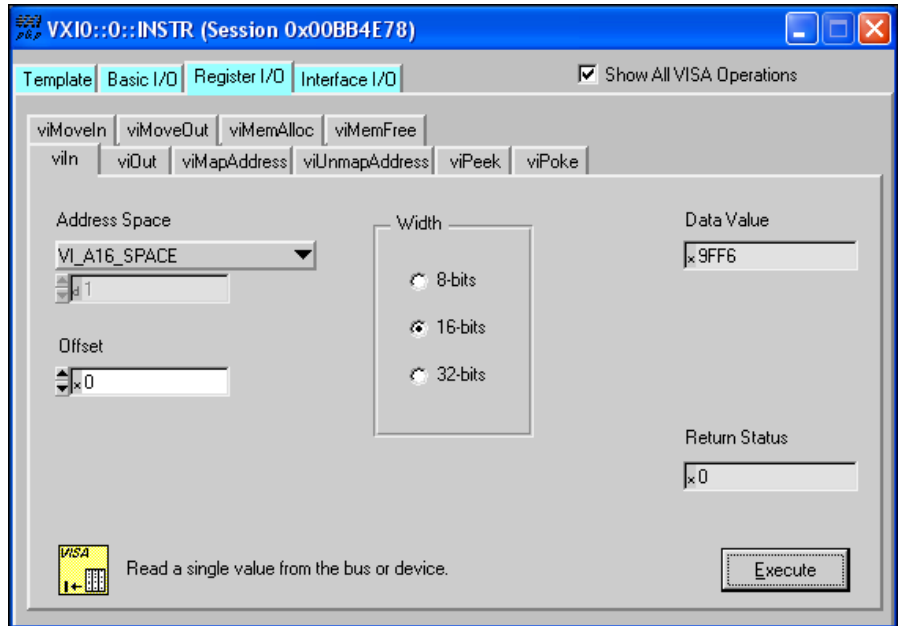
**Note** You can also use VXI Interactive Control Program (VIC) to control your VXI/VME devices and develop and debug VXI application programs. VIC is not included in the default NI-VXI installation. To install VIC, select **NI-VXI API Development** in the installer. You can launch VISAIC (or VIC) from the **Tools** menu in MAX or from the **VISA** or **VXI** subgroups in **Start>Programs>National Instruments**.

Try the following in VISAIC: In the tree view, navigate using your mouse to the VISA resource for your controller—probably VXI0::0::INSTR, representing the VXI system 0, logical address 0 instrument resource, as shown in Figure 3-2.



**Figure 3-2.** Select Your Controller in VISAIC

Open the selected resource and navigate to the Register I/O tab (**Show all VISA operations** must be turned on for this to be visible). In this tab, you can read registers on your device, such as the VXI device configuration registers. Execute the viIn operation (called In in LabVIEW compatibility mode) with the default parameters. The Data Value field shows the I/O operation result, such as 0x9ff6. The Return Value field shows the function status, such as 0 for VI\_SUCCESS, as shown in Figure 3-3.



**Figure 3-3.** Successful viIn Access in the VISAIC Register I/O Tab  
(This Window May Look Slightly Different for LabVIEW Users)

If the data value ends in FF6, you have successfully read the National Instruments manufacturer ID from your VXI/VME controller's ID register. You may now want to read the configuration registers from other VXI devices in your system by opening the devices in VISAIC. Try reading a register from each device listed in the MAX view of your VXI system. This way, you can verify that your VXI controller can access each device in your VXI system successfully. You can also access VXI and VME devices configured in A16, A24, or A32 space by opening the VXI MEMACC resource, which is VISA's representation of VXI memory. For more information about VISAIC operations and commands, refer to the online help in the **Help** menu and the context-sensitive help (such as What's This?), available by right-clicking in any panel. You also can right-click over items in panels for details on their purpose.

# Programming for VXI

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NI-VISA and the NI-VXI API are the two National Instruments programming interfaces for accessing your VXI/VME instruments. With NI-VXI 3.0 or later, NI-VISA is the native API for communicating with a VXI or VME system, and NI recommends using it for all new applications. Older programs that use the NI-VXI API now use the NI-VXI-to-NI-VISA compatibility layer to communicate with the VXI devices. Using this layer, older programs can run in NI-VXI 3.0 or later without being rewritten to use the VISA interface.



**Note** The NI-VXI API development environment is not installed by default as part of the NI-VXI installation. NI recommends using NI-VISA rather than NI-VXI for all new VXI/VME applications. If you must develop an application using the older NI-VXI API, run the NI-VXI installer and select the **NI-VXI API Development** option in the Feature Selection screen. Be sure to review the [NI-VXI API Notes](#) section of this manual.

NI-VISA is the National Instruments implementation of the VISA API as the VXI *plug&play* standard defines. It provides a common interface to many types of instruments (such as VXI, GPIB, PXI, Serial, TCP/IP, and so on) and therefore is especially useful in situations where you are using multiple types of instruments.

Both NI-VISA and the NI-VXI API include functions for register-level access to VXI instruments and messaging capability to message-based devices. You can also use either interface to service asynchronous events such as triggers, signals, and interrupts, and also assert them. Compatibility with the NI-VXI API is included for legacy applications only—NI recommends that you write all new VXI/VME applications in VISA.

The best way to learn NI-VISA programming is by reviewing the example programs your software includes. The examples directory contains working VISA programs that illustrate many different types of applications. You can find these examples in the Windows Start menu under **Programs» National Instruments» VISA» Examples**.

If you are just getting started, you should learn how to access registers with high-level calls and send messages with word-serial functions. The NI-VISA examples for these tasks are `HighReg.c` and `RdWrt.c`. Refer to the other examples as you try more advanced techniques. Consult the NI-VISA online help for additional information about these topics.

Table 3-1 summarizes the topics the example programs address. All files are found through the Windows Start menu under **Programs»National Instruments»VISA»Examples**, in the subdirectories listed below.

**Table 3-1.** NI-VISA/NI-VXI Examples

Coverage	NI-VISA Example	NI-VXI Example (Optional)
Message-Based Access	C\General\RdWrt.c	VXIws.c
High-Level Register Access	C\VXI-VME\HighReg.c	VXIhigh.c
Low-Level Register Access	C\VXI-VME\LowReg.c	VXIlow.c
Interrupt Handling	C\VXI-VME\AsyncIntr.c and WaitIntr.c	VXIint.c
Trigger Handling	C\VXI-VME\WaitTrig.c	VXItrig.c



**Note** MAX includes configuration options that affect low-level functions and shared memory, as well as trigger mappings and other attributes of your VXI system. Refer to the MAX online help for information regarding these options.

## Optimizing Large VXIbus Transfers

For best performance, keep the following in mind when using `viMove()` or `VXImove()`:

- Make sure your buffers are 32-bit aligned.
- Transfer 32-bit data whenever possible.
- Use VXI block access privileges to significantly improve performance to devices that can accept block transfers, and likewise use D64 access privileges for devices that can accept the VME64 64-bit data transfer protocol.
- To optimize move performance on virtual memory systems such as the Windows operating system, lock the user buffer in memory yourself so the move operation does not need to lock the buffer.
- To optimize move performance on paged memory systems such as the Windows operating system, use a contiguous buffer so the move operation does not need to build a scatter-gather list for the user buffer.



**Note** `viMemAlloc()` or `VXImemAlloc()` returns 32-bit aligned, page-locked, continuous buffers that work efficiently with the move operations.

## NI-VXI API Notes

The following notes apply only if you are using the NI-VXI API. National Instruments recommends that all new VXI/VME applications use the NI-VISA API, but you can still develop with the older NI-VXI API for compatibility with legacy code.

### Compiler Symbols

You may need to define certain compiler symbols so that the NI-VXI library can work properly with your program. The required symbol indicates your operating system platform; for example, `VXINT` designates the application as a Windows 2000/NT/XP/Me/98 application.



**Note** LabWindows/CVI automatically defines the correct symbol. You do not need to define `VXINT` when using LabWindows/CVI.

The additional symbol `BINARY_COMPATIBLE` is optional. It ensures that the resulting application is binary compatible with other National Instruments VXI controllers using the same operating system. This symbol may cause a slight performance degradation when you use low-level VXIbus access functions on some controllers.

You can define these symbols using `#define` statements in your source code or using the appropriate option in your compiler (typically either `-D` or `/D`). If you use `#define` statements, they must appear in your code before the line that includes the NI-VXI API header `nivxi.h`.

### Compatibility Layer Options

Although NI-VXI supports multiple VXI controllers through NI-VISA, the NI-VXI API supports only a single controller. To specify which controller the emulation layer should use, run `MAX`. Select **Tools»NI-VXI»VXI Options**. Select the VXI system that will support the emulation layer.

In NI-VXI 3.0 or later, when you enable for triggers or interrupts, only the local controller is enabled. In the NI-VXI API functions for enabling triggers and interrupts, the controller parameter is ignored. If you need to enable a remote controller for triggers, use the `MAX` frame resource to map the trigger back to the local controller. Refer to the *NI-VISA Help* for additional information.

The interrupt and trigger routing in the NI-VXI 3.0 or later low-level drivers is somewhat different from the default routing in previous versions of NI-VXI. Therefore, the compatibility layer may behave differently than the original NI-VXI API with regard to these settings. In particular, if you are receiving triggers on an external controller, you may need to modify the trigger configuration on your extender module using MAX. Consult the manual for your extender module for details. In general, interrupts are routed automatically based on the interrupt configuration the resource manager detects. Whether the changed routing behavior affects your program is application dependent.

Because VISA is an instrument-centric API, certain functions from the more controller-centric NI-VXI API do not match perfectly with a VISA counterpart. When an application enables an event with the NI-VXI API compatibility layer, each logical address is enabled for that event separately. For example, if the application enables an interrupt level, VISA will enable the interrupt on each logical address, one at a time, until all the devices are enabled. This means that some interrupts could be lost from devices with higher numbered logical addresses. MAX provides an option for users to pick which logical address is enabled first. Select **Tools»NI-VXI»VXI Options**. Set **Prioritized Signal LA** to the logical address of the device that generates the events. This prevents possible loss of events from that device.

## Debugging

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NI Spy and VISAIC are useful utilities for identifying the causes of problems in your application, and are installed by default with your NI-VXI installation.

NI Spy tracks the calls your application makes to National Instruments programming interfaces, including NI-VISA, NI-VXI, and NI-488. NI Spy highlights functions that return errors, so during development you can quickly spot which functions failed during a program's execution. NI Spy can log the calls your program makes to these drivers so you can check them for errors at your convenience, or use the NI Spy log as a reference when discussing the problem with National Instruments technical support. Figure 3-4 shows an example of an error returned from a call to `viMemAlloc`.

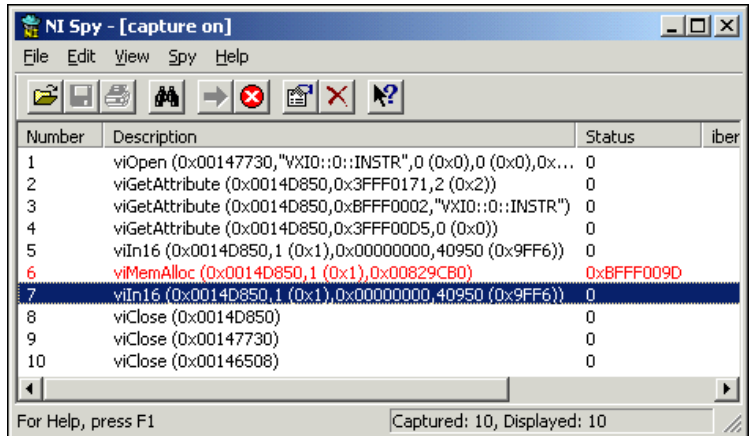


Figure 3-4. NI Spy

VISAIC, as shown in Figure 3-5, is an excellent platform for quickly testing instruments and learning how to communicate with them. This utility is further discussed in the *Device Interaction* section of this chapter.

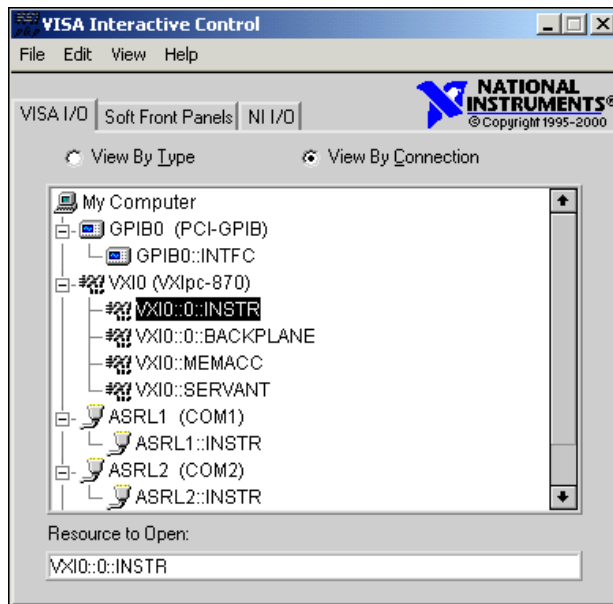


Figure 3-5. VISAIC

## Specifications

This appendix lists the specifications for the VXI-MXI-Express Series controller.

### Power Requirement

Voltage	Current	
	Typical (DC)	Dynamic
+5 V	1.600 A	1.600 A
+12 V	0.020 A	0.020 A
-5.2 V	0.177 A	0.125 A
-2 V	0.060 A	0.125 A

### EXT CLK

Output Drive ..... 50  $\Omega$  source terminated  $\pm 24$  mA output driver

$V_{OL}$  ..... <800 mV

$V_{OH}$  ..... >2.0 V

Input Buffer ..... TTL compatible input buffer

### TRIG IN

Input Buffer ..... TTL compatible input buffer



## TRIG OUT

---

Output Drive .....	50 $\Omega$ source terminated $\pm 40$ mA output driver
V <sub>OL</sub> .....	<800 mV
V <sub>OH</sub> .....	>2.0 V

## Physical

---

Size .....	C size, C-1
Dimensions .....	23.3 $\times$ 43.0 cm (9.2 $\times$ 13.4 in.)
Weight .....	1.292 kg (45.6 oz)
I/O connectors	
SMB .....	3
Slot requirements .....	Single VXI C-size slot
Compatibility .....	Fully compatible with VXI specification
VXI keying class .....	Class 1 TTL
MTBF .....	Contact factory

## Environmental

---

Maximum altitude .....	2,000 m
Pollution Degree .....	2
Indoor use only.	

## Operating Environment

Ambient temperature range.....	0 to 55 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2; meets MIL-PRF-28800F Class 3 low temperature limit and MIL-PRF-28800F Class 2 high temperature limit.)
Relative humidity range .....	10% to 90% (Tested in accordance with IEC-60068-2-56.)

## Storage Environment

Ambient temperature range.....	–40 to 85 °C (Tested in accordance with IEC-60068-2-1 and IEC-60068-2-2; meets MIL-PRF-28800F Class 3 limits.)
Relative humidity range .....	5% to 95% (Tested in accordance with IEC-60068-2-56.)
EMI .....	FCC Class A verified, EC verified

## Shock and Vibration

Operational shock .....	30 g peak, half-sine, 11 ms pulse (Tested in accordance with IEC-60068-2-27; meets MIL-PRF-28800F Class 2 limits.)
Random vibration	
Operating .....	5 to 500 Hz, 0.3 g <sub>rms</sub>
Nonoperating .....	5 to 500 Hz, 2.4 g <sub>rms</sub> (Tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.)

## Safety

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This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN-61010-1
- UL 61010-1, CSA 61010-1



**Note** For UL and other safety certifications, refer to the product label or visit [ni.com/certification](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

## Electromagnetic Compatibility

---

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A



**Note** For EMC compliance, operate this device according to product documentation.

## CE Compliance

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This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)



**Note** Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit [ni.com/certification](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

# Environmental Management

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National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at [ni.com/environment](http://ni.com/environment). This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

## Waste Electrical and Electronic Equipment (WEEE)



**EU Customers** At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit [ni.com/environment/weee.htm](http://ni.com/environment/weee.htm).

## 电子信息产品污染控制管理办法（中国 RoHS）



**中国客户** National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 [ni.com/environment/rohs\\_china](http://ni.com/environment/rohs_china)。(For information about China RoHS compliance, go to [ni.com/environment/rohs\\_china](http://ni.com/environment/rohs_china).)

# Cleaning

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If you need to clean the module, use a soft, nonmetallic brush. Make sure that the module is completely dry and free from contaminants before returning it to service.

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## Default Settings

This appendix summarizes the default settings for the hardware and software in the VXI-MXI-Express kit. If you need more information about a particular setting or want to try a different configuration, refer to Appendix C, *Advanced Hardware Configuration Settings*, for your hardware reference and to the MAX online help for your software reference.

### Default Hardware Settings

---

Figure B-1 and Table B-1 show the factory-default settings of the user-configurable jumpers on the VXI-MXI-Express Series controller. Tables B-2, B-3, B-4, B-5, and B-6 show user-configurable settings in Measurement & Automation Explorer (MAX).

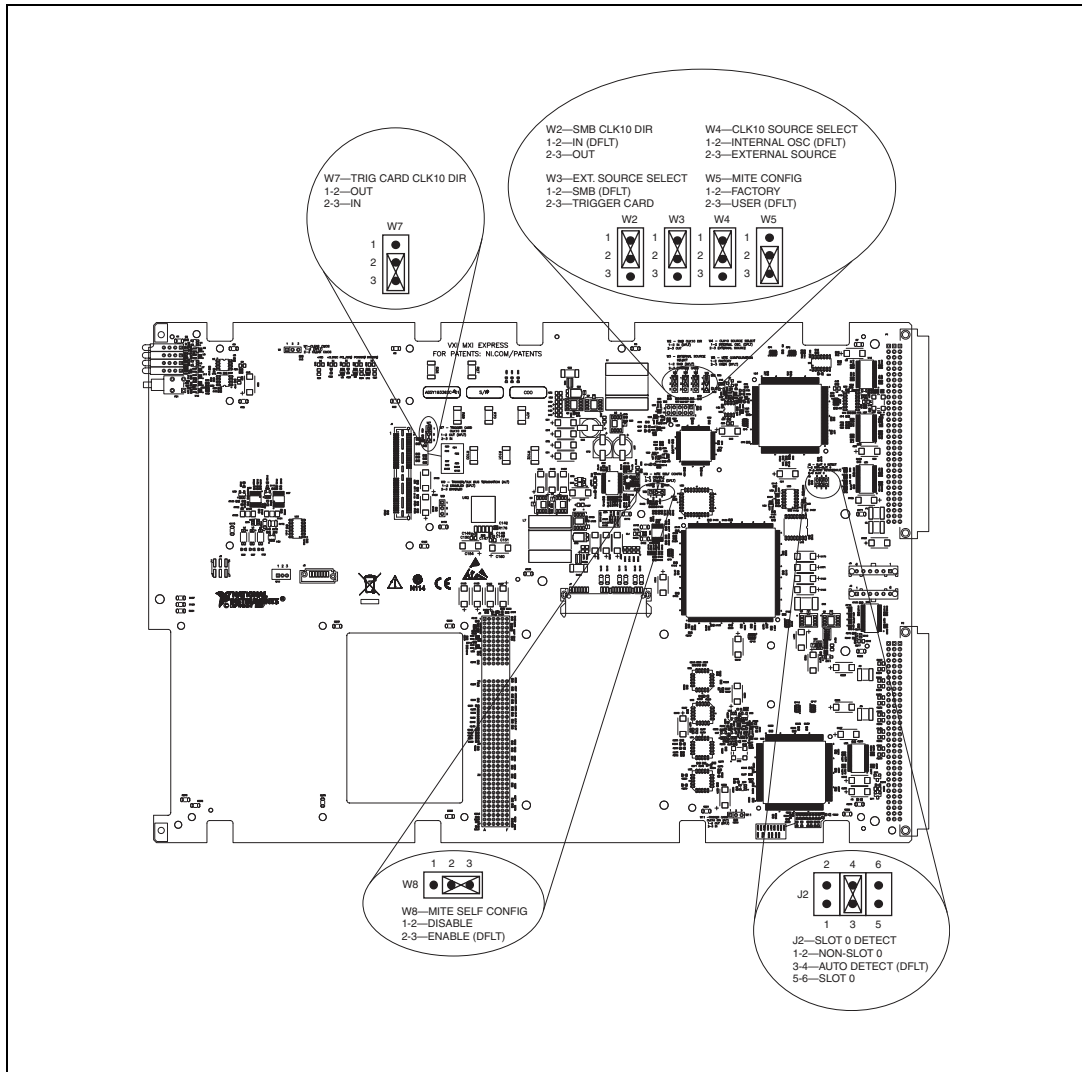


Figure B-1. VXI-MXI-Express Shipping Configuration Settings

**Table B-1.** VXI-MXI-Express Series Controller Hardware Default Settings

<b>Jumper</b>	<b>Description</b>	<b>Setting</b>
W2	SMB CLK10 DIR	1–2 In (Default) 2–3 Out
W3	External CLK10 Source Select	1–2 SMB (Default) 2–3 Trigger Card
W4	CLK10 Source Select	1–2 Internal Osc. (Default) 2–3 Exteranl Source
W5	MITE Configuration	1–2 Factory 2–3 User (Default)
W7	Trigger Card CLK10 Direction	1–2 Out 2–3 IN
W8	MITE Self Configuration	1–2 Disable 2–3 Enable (Default)
J2	Slot 0 Detect	1–2 Non-Slot 0 3–4 Auto Detect (Default) 5–6 Slot 0

## Default Software Settings

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The following hardware configurations are available through Measurement & Automation Explorer (MAX).

**Table B-2.** MAX Device Tab Default Settings

<b>Editor Field</b>	<b>Default Setting</b>
Device class	Message-based
Number of handlers	1

**Table B-3.** MAX Shared Memory Tab Default Settings

<b>Editor Field</b>	<b>Default Setting</b>
Don't share memory	
A24/A32 write posting	Enabled

**Table B-4.** MAX VXI Bus Tab Default Settings

<b>Editor Field</b>	<b>Default Setting</b>
Bus timeout value	500 $\mu$ s
VXI retry generation	Enabled
Automatic retries	Enabled
VXI transfer limit	256
A24/A32 write posting	Enabled
Requester mode	Release on Request
Request level	3
Operate as fair requester	Enabled
Bus arbitration mode	Prioritized
Arbiter timeout	Disabled

**Table B-5.** MAX PCI Tab Default Settings

<b>Editor Field</b>	<b>Default Setting</b>
Low-level register access API support	Enabled
User window size	512 kKB
DMA setting	Enable DMA on this controller

**Table B-6.** MAX SMB Tab Default Settings

<b>Editor Field</b>	<b>Default Setting</b>
CLK10 50 $\Omega$ termination	Disabled
Invert CLK10 polarity	Enabled
TRIG IN 50 $\Omega$ termination	Disabled





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# Advanced Hardware Configuration Settings

This appendix describes the alternate hardware configuration settings for the VXI-MXI-Express Series controller. The board is set at the factory for the most commonly used configuration. Use this appendix if you want to try a different hardware configuration or if you would like more information on a particular setting. This information is intended for more advanced users.

The following hardware configuration settings are user configurable.

- Slot 0 detection
- VXIbus CLK10 routing
- SMB Trigger I/O
- Backplane trigger I/O

For the configuration switch locations and default settings, see Figure B-1, *VXI-MXI-Express Shipping Configuration Settings*.



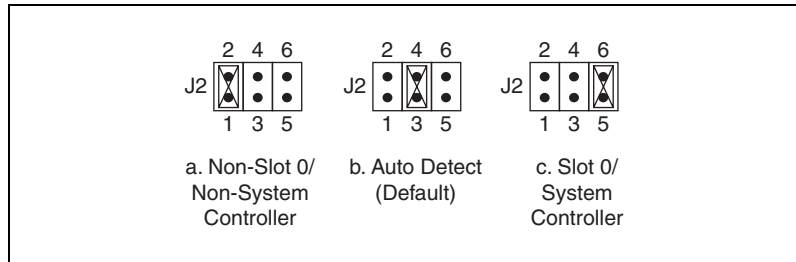
**Note** Do *not* attempt an alternate setting unless you are familiar with its purpose. In addition, do not reconfigure any switches or jumpers not described in this appendix unless directed by National Instruments support.

## Slot 0 Detection

---

The VXI-MXI-Express Series controller is configured at the factory to automatically detect if it is installed in Slot 0 of a VXI mainframe. With automatic System Controller slot detection the VXI-MXI-Express Series controller can be installed in any VXIbus slot.

The VXI-MXI-Express Series controller can be manually configured for either System Controller or Non-System Controller operation by defeating the automatic detection circuitry. Use the three position jumper J2 as shown in Figure C-1 to select between automatic detection, System Controller, or Non-System Controller.



**Figure C-1.** Slot 0 Detection through the J2 Jumper



**Caution** Do *not* install a device configured as the System Controller in any slot other than Slot 0. When installing into a slot other than Slot 0, first reconfigure it as either a Non-System Controller or for automatic detection. Failing to do so may result in damage to the VXI-MXI-Express Series controller and/or the backplane.

When the VXI-MXI-Express Series controller installed in Slot 0 of a VXI system it becomes the VXIbus System Controller. As the System Controller the VXI-MXI-Express Series controller has VXIbus Data Transfer Arbiter circuitry that accepts bus requests on all four VXIbus request levels, prioritizes the requests, and grants the bus to the highest priority requester. As the VXIbus System Controller the VXI-MXI-Express Series controller also drives the 16 MHz VXIbus system clock via an onboard 16 MHz oscillator. As required by the specification, when installed in Slot 0, the VXI-MXI-Express Series controller drives CLK10, a differential ECL output, to the VXIbus backplane. When the system is not installed in Slot 0 it will only receive the CLK10 signal.

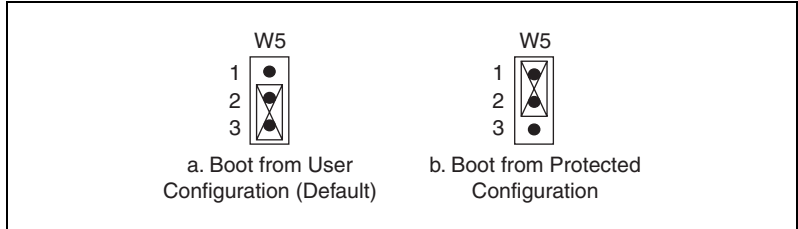
## MITE EEPROM

### User/Factory Configuration

The EEPROM is divided into two halves—one half is factory configured and one half is user configurable. Use jumper W5 to control whether the VXI-MXI-Express Series controller boots off the factory-configured EEPROM settings or the user-modified settings. In its default setting, the VXI-MXI-Express Series controller boots off the user-configurable half.

This jumper is useful in the event that the user-configured half of the EEPROM becomes corrupted in such a way that the VXI-MXI-Express Series controller boots to an unusable state. By changing this jumper setting, you can boot to the factory configuration and get up and running again. Use the procedure as described in the [How to Fix an Invalid EEPROM Configuration](#) section of this manual.

Figure C-2 shows the configuration settings for EEPROM operation.

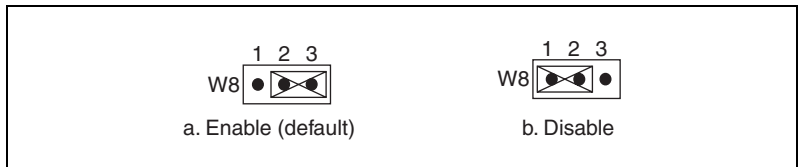


**Figure C-2.** EEPROM Configuration

## Power-On Self Configuration

The VXI-MXI-Express Series controller has an onboard EEPROM, which stores default register values for the VXI circuitry. These values are loaded when you power up the computer. The values read from the EEPROM program the PCI interface and the VXIbus registers so that the VXI interface is ready to respond to Resource Manager accesses within the required 5 seconds of SYSRST# deasserting.

You can disable this power-on self-configuration (POSC) circuit by changing switch W8. Although this makes the VXI circuitry unusable, it is sometimes helpful in debugging address and interrupt conflicts with add-in boards. In general, however, you should leave W8 in its factory-default setting. Figure C-3 shows the possible configurations for W8.



**Figure C-3.** Power-on Self Configuration Status

## How to Fix an Invalid EEPROM Configuration

Use MAX under Windows to edit the VXI-MXI-Express Series controller configuration. Some of these settings are stored in files that the NI-VXI software reads, while other settings are stored directly in the VXI-MXI-Express Series controller EEPROM.

Certain EEPROM configurations, including invalid configurations, can lock up your computer while it is booting. Generally, only the size and

location of the memory windows can cause the VXI-MXI-Express Series controller to lock up your system. For example, many PCI-based computers will not boot if a board in its system requests more memory space than the computer can allocate. If you encounter this situation, you should reduce the size of the VXI-MXI-Express Series controller user memory window. The EEPROM can become corrupted if the VXI-MXI-Express Series controller is shut down while it is updating the EEPROM.

If one of these situations occurs after you change the configuration, complete the following steps to reconfigure the VXI-MXI-Express Series controller.

1. Power off your computer.



**Caution** To protect both yourself and the mainframe from electrical hazards, the mainframe should remain off until you finish changing the settings on the VXI-MXI-Express Series controller.

2. Change jumper W5 to the position shown in Figure C-2b to restore the factory configuration.
3. Power on the computer. The computer should boot this time because the factory-default configuration is being used to initialize the VXI-MXI-Express Series controller.
4. Run your software configuration utility to re-adjust the VXI-MXI-Express Series controller configuration.
5. After saving the configuration, exit Windows and power off the computer.
6. Change jumper W5 to the default position, as shown in Figure C-2a.
7. Power on the computer. If the computer does not boot with this configuration, you will need to repeat these steps, modifying your configuration until a final configuration is reached.

## VXIbus CLK10 Routing

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When the VXI-MXI-Express Series controller is installed in Slot 0 of your mainframe, it supplies the VXIbus CLK10 signal. Three different sources for CLK10 are available with the VXI-8360T:

- The internal 10 MHz  $\pm$ 100 ppm CLK10 oscillator. This is the default CLK10 source.
- The front panel CLK10 SMB. When configured as an input the front panel SMB allows an external source to be used as the source for the VXIbus CLK10 signal.

- The front panel TRIG/CLK PORT A(B). CLK10 can be routed into the VXI-8360T from another VXI-8360T through the TRIG/CLK PORT A(B) on the front panel. Onboard jumpers are used to set this configuration.

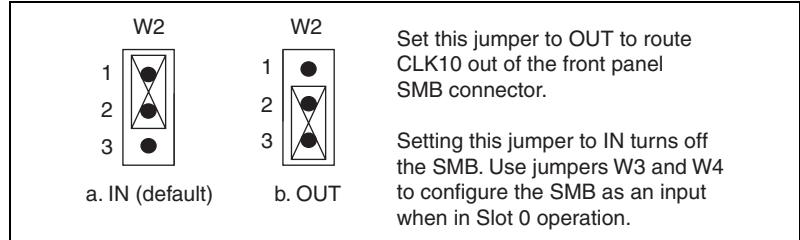
## Front Panel SMB Direction Control

### W2—SMB CLK10 Direction

This jumper allows you to configure the front panel SMB connector on the VXI-MXI-Express Series controller.

The default jumper position, shown in Figure C-4a, **In**, shuts off CLK10 to the front panel SMB connector. Use jumpers W4 and W3 to configure the front panel SMB as an input for CLK10. In non-Slot 0 operation the SMB cannot be configured as an input as only the Slot 0 controller is allowed to supply CLK10 to the VXI backplane.

Setting the W2 jumper to **Out**, as shown in Figure C-4b, routes the VXIbus CLK10 to the front panel SMB connector. In non-Slot 0 operation this jumper will also route the VXIbus CLK10 out of the front panel SMB connector.



**Figure C-4.** Setting the Front Panel CLK10 SMB Direction with Jumper W2

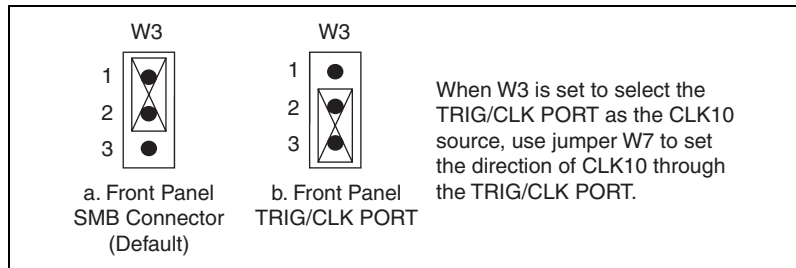
## Selecting the CLK10 Source

### W3—External CLK10 Source Select

When W4—CLK10 Source Select is set to select an external CLK10 source, W3 is used to select between two external CLK10 sources.

- The default setting, shown in Figure C-5a, **SMB**, selects the front panel SMB connector as the external CLK10 source. There is no need to set the direction of the SMB with jumper W2 as the controller will set the SMB as an input for you.

- Set the W3 jumper to **TRIG/CLK PORT A(B)**, shown in Figure C-5b, to select the CLK10 source as the TRIG/CLK PORT A(B) on the VXI-8360T front panel. When selecting the trigger card as the CLK10 input source be sure to set jumper W7 to set the direction of CLK10 through the TRIG/CLK PORT A(B).



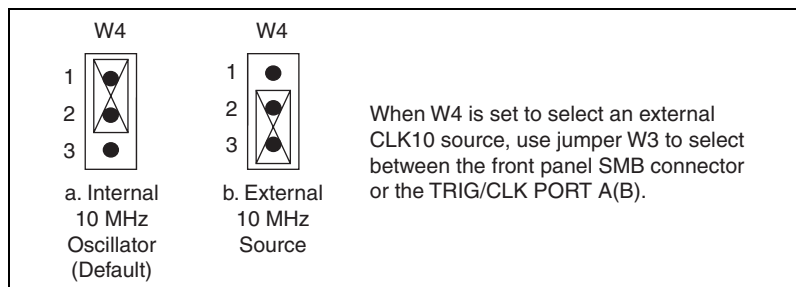
**Figure C-5.** Selecting the External CLK10 Source with the W3 Jumper

## W4—CLK10 Source Select

In Slot 0 operation the CLK10 Source Select jumper allows you to select the source for the VXIbus CLK10 that is routed to the backplane.

The default setting, **Internal Oscillator**, shown in Figure C-6a, uses the internal 10MHz  $\pm 100$  ppm oscillator as the VXIbus CLK10 source.

Set the W4 jumper to **External Source**, shown in Figure C-6b, to use the front panel SMB or the TRIG/CLK PORT A(B) as the CLK10 source. Jumper W3 External CLK10 Source Select is used in conjunction with W4 when W4 is set to select an external oscillator as the VXIbus CLK10 source.



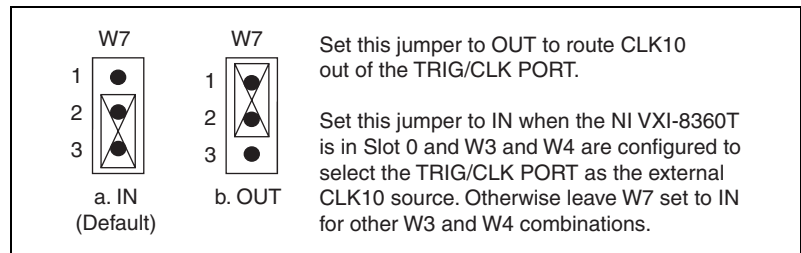
**Figure C-6.** Selecting the CLK10 Source with the W4 Jumper

## TRIG/CLK PORT A(B) Direction

### W7—Trigger Card CLK10 Dir

This jumper allows you to configure the direction of CLK10 through the TRIG/CLK PORT A(B).

- In Slot 0 operation with jumpers W4 set for an external source and W3 set for the front panel TRIG/CLK PORT A(B) set this jumper to **In**, as shown in Figure C-7a, to route CLK10 in from another NI VXI-8360T to the VXI backplane. In non-slot 0 operation the **In** setting has no effect.
- In Slot 0 and non-Slot 0 operation setting this jumper to **Out**, as shown in Figure C-7b, routes the VXIbus CLK10 out of the TRIG/CLK PORT A(B).



**Figure C-7.** Setting the TRIG/CLK PORT A(B) Direction with Jumper W7

## Optional CLK10 Settings

### Inverting CLK10

If the front panel SMB connector EXT CLK is configured as an output this software setting provides the capability to invert the clock output. This setting can be found in the hardware configuration panels in MAX as shown in Figure C-8.

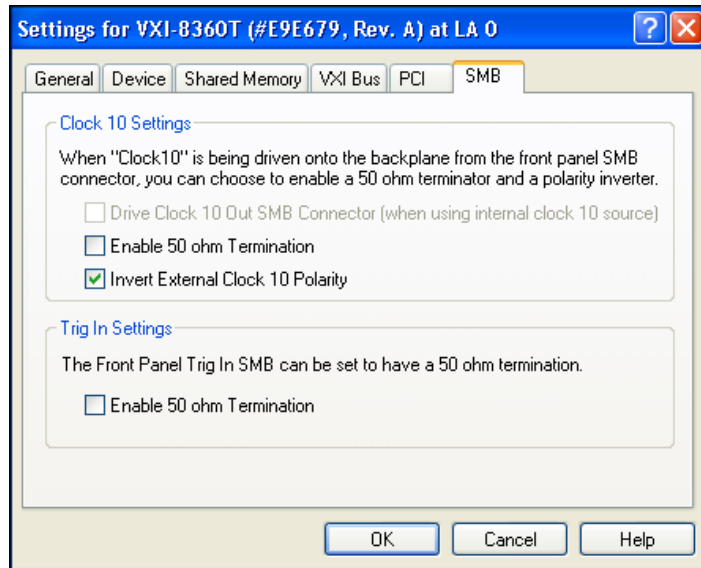


Figure C-8. Inverting the CLK10 Signal through MAX

## CLK10 Termination

If the front panel SMB connector EXT CLK is configured as an input this software setting can enable 50  $\Omega$  parallel termination. This setting can be found in the hardware configuration panels in MAX, as shown in Figure C-8.

## Trigger Input Termination

Optional software enabled 50  $\Omega$  parallel termination is available for the front panel trigger input. This setting can be found in the hardware configuration panels in MAX, as shown in Figure C-8.



**Note** Parallel termination is not necessary when the signal is driven by a 50  $\Omega$  source, such as a VXI-MXI-Express Series controller.



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# Using The Trigger Ports On The VXI-8360T

The NI VXI-8360T allows you to extend the 8 TTL backplane triggers and CLK10 between chassis through convenient front panel connectors. Each trigger and the CLK are independently configurable as either inputs or outputs of the frame. The trigger bus is connected in a daisy chain topology and can support up to six (6) devices with a total of 19 m of cables.



**Cautions** The trigger bus uses the MXI-Express x4 cables, however these are not MXI-Express x4 ports. Do *not* connect the trigger ports to a MXI-Express x4 or PCI Express x4 device.

The trigger bus may be able to support more devices and/or greater cable lengths, but these configurations have not been validated by National Instruments and are not currently supported.

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## Connecting the Trigger Port Cables

When connecting the cables between two devices on the trigger bus, always ensure you connect TRIG/CLK PORT A of one device to TRIG/CLK PORT B of the second device, or TRIG/CLK PORT B of one device to TRIG/CLK PORT A of the second device, as shown in Figure D-1. The front panel LED will blink red if the cables are not connected correctly. The LED will be lit steady state green if they are connected properly.



**Note** Trigger bus cables may be removed and inserted while power is on.

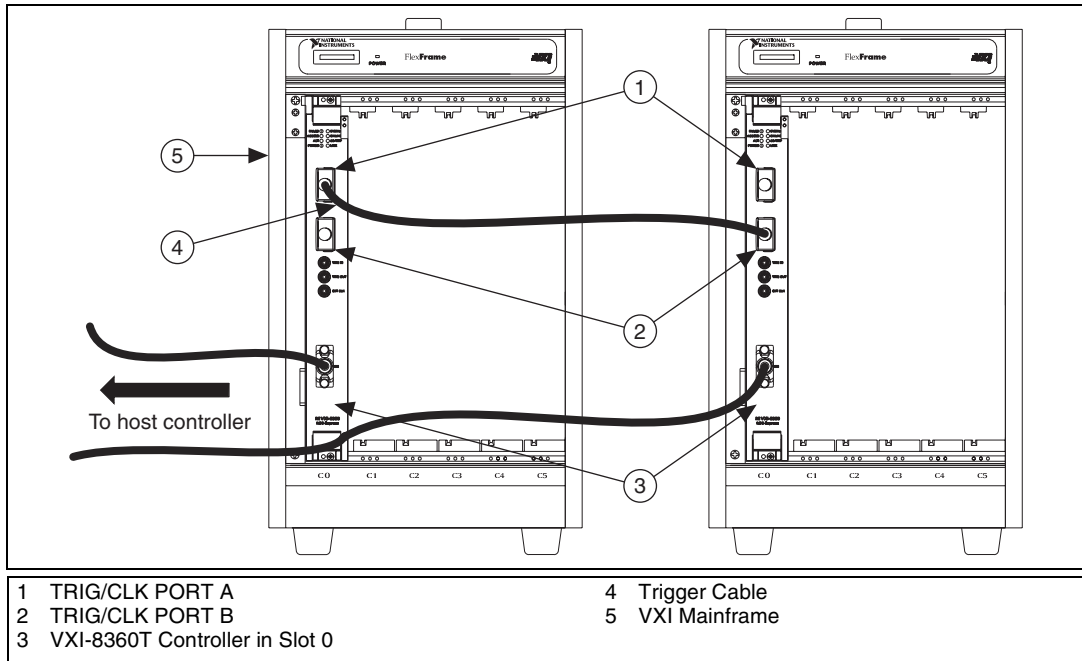


Figure D-1. VXI-MXI-Express Series Controller Trigger Cabling

## Software Configuration

Triggers are mapped into and out of your NI VXI-8360T though software using the following steps.

1. Open MAX.
2. Find your device under **Devices and Interfaces**.
3. Right click on your device and select **Properties**.
4. Click on the **Signal Mappings Tab**.
5. From each TTL Trigger select **Into the Frame, Out of the Frame, or None**.
6. Click **OK** and re-run the VXI Resource Manager (Resman) for the changes to take effect.



**Note** Do not map the same trigger out of the frame on more than one device on the trigger bus. This will cause the bus to be driven by more than one device. Protection circuitry prevents this from causing physical damage, however your setup will not function properly.



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# VMEbus Capability Codes

This appendix summarizes the VMEbus capability codes for the hardware and software in the VXI-MXI-Express kit.

## VMEbus Capability Codes

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Capability Code	Description
A32, A24, A16 (master)	VMEbus master A32, A24, and A16 addressing
A32, A24, A16 (slave)	VMEbus slave A32, A24, and A16 addressing
D32, D16, D08(EO) (master)	VMEbus master D32, D16, and D08 data sizes
D32, D16, D08(EO) (slave)	VMEbus slave D32, D16, and D08 data sizes
BLT, MBLT (master)	VMEbus master block and D64 transfers
BLT, MBLT (slave)	VMEbus slave block and D64 transfers
RMW (master)	VMEbus master read/modify/write transfers
RMW (slave)	VMEbus slave read/modify/write transfers
RETRY (master)	VMEbus master retry support
RETRY (slave)	VMEbus slave retry support
FSD	First slot detector
SCON	VMEbus System Controller
PRI, RRS	Prioritized or Round Robin Select arbiter
ROR, FAIR	Release on Request and FAIR bus requester
IH(7-1)	Interrupt handler for levels 7-1
I(7-1)	Interrupt requester for levels 7-1
D32, D16, D08(O) (Interrupt Handler)	VMEbus D32, D16, D08(O) interrupt handler
D32, D16, D08(O) (Interrupter)	VMEbus D32, D16, D08(O) interrupter

<b>Capability Code</b>	<b>Description</b>
ROAK, RORA	Release on Acknowledge or Register Access interrupter
BTO(x)	VMEbus bus timer (programmable limit)

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## Common Questions

This appendix addresses common questions you may have about using the NI-VISA/NI-VXI software on the VXI-MXI-Express Series controller platform.

### **What is the maximum length of the VXI-MXI-Express Series controller copper cable?**

The maximum length for the VXI-MXI-Express Series controller copper cable is 7 m. National Instruments offers 1 m, 3 m, and 7 m copper cables.

### **I need more devices than can fit in one chassis. How can I expand my VXI-MXI-Express Series controller system?**

Many applications can be easily extended to multiple chassis by adding additional VXI-MXI-Express Series controllers to the host computer and using the trigger and clock sharing features of the VXI-8360T to synchronize events between chassis. In the event that VXI or VME bus mastering devices must communicate to devices in other chassis directly, National Instruments recommends that you use a VXI-MXI-2 interface, which implements the VXI-6 specification for mainframe extension. This extends full VXI functionality across multiple mainframes, including a common device address space, interframe triggering, interrupts, and bus mastering. Place a VXI-MXI-2 in the same mainframe with the Slot 0 VXI-MXI-Express Series controller, and another VXI-MXI-2 in Slot 0 of the next mainframe. You can then fill up this mainframe with additional devices. Refer to the *MXI-2 Configuration Reference Manual* available at [ni.com](http://ni.com) for additional configuration instructions.

### **How can I determine the serial number of the VXI-MXI-Express Series controller?**

This information is displayed in the title bar of the Hardware Configuration window in MAX.

### **What is Resman?**

Resman is the utility that performs the duties of a VXI Resource Manager as discussed in the VXIbus specification. When you set a National Instruments controller to Logical Address 0, you will at some point need to run Resman to configure your VXI instruments. If your controller uses a different (nonzero) logical address and is a message-based device, you need to start Resman before running it on the Logical Address 0 computer.

### **When do I need to run Resman?**

Run Resman whenever you need to configure your VXI instruments (for example, when you power cycle either the host computer or the chassis).

### **Which NI-VXI utility program must I use to configure the VXI-MXI-Express Series controller?**

Use Measurement & Automation Explorer (MAX) to configure the VXI-MXI-Express Series controller. MAX is in the `National Instruments` program group folder, and a shortcut is on your desktop.

### **How do I handle VME devices?**

Although there is no way to automatically detect VME devices in a system, you can add them easily through the Add Device Wizard in MAX. Through this procedure, you can reserve resources for each of your VME devices and configure MAX to show VME devices on the screen with all your other devices.

### **Which NI-VXI utility program must I use to perform startup Resource Manager operations?**

Use the Resman program to perform startup Resource Manager operations in **Start»Programs»National Instruments»VXI**. Resman uses the settings configured in MAX. It initializes your VXI/VMEbus system and makes the information it collects accessible through MAX. You can also run Resource Manager operations from MAX. Through MAX, you can also configure Resman to run automatically at Windows startup.

### **What can I do to make sure that my system is up and running?**

The fastest method for testing the system is to run Resman. This program attempts to access memory in the upper A16 address space of each device in the system. If Resman does not report any problems, the VXI-MXI-Express Series controller communication system is operational. To test individual devices, you can use the VIC or VISAIC program to

interactively issue NI-VXI functions or NI-VISA operations, respectively. You can use `viIn()` and `viOut()` with the NI-VISA API (or `VXIin()` or `VXIinReg()` and `VXIout()` or `VXIoutReg()` with the NI-VXI API) to test register-based devices by programming their registers. If you have any message-based devices, you can send and receive messages with the `viRead()` and `viWrite()` operations in the NI-VISA API (or `WSrd()` and `WSwrt()` functions in the NI-VXI API). Notice that `VXIinReg()` and `VXIoutReg()` are for VXI devices only, but you can use `VXIin()` and `VXIout()` for both VXI and VME. Finally, if you are using LabVIEW or LabWindows/CVI and you have instrument drivers for the devices in your chassis, you can use the interactive features of these programs to quickly test the functionality of the devices.

### What do the LEDs on the front of the VXI-MXI-Express Series controller mean?

The VXI-MXI-Express Series controller has the following front panel LEDs:

- **FAILED**—Indicates the VXI-MXI-Express Series controller failed power on diagnostics.
- **SYSFAIL**—Indicates the VMEbus SYSFAIL line has been asserted on the backplane.
- **ONLINE** —Indicates the board is detected and ready for use.
- **ACCESS**—Indicates a VXI bus master is accessing the VXI MXI-Express Series controller.
- **CB**—Indicates the circuit breaker has tripped from an over current condition on the +5.0 V<sub>DC</sub> rail of the VXI-MXI-Express Series controller.
- **ACT**—Indicates bus activity on the MXI-Express link.
- **PWRGD**—Indicates the on board power supplies are in regulation.
- **LINK**—Indicates the MXI-Express link connecting the host computer to the VXI-MXI-Express Series controller has been established.

### What kind of signal is CLK10 and what kind of signal do I need for an external CLK10?

CLK10 is a differential ECL signal on the VXIbus backplane. However, the oscillator for the VXI-MXI-Express Series controller and the EXT CLK SMB input from the front panel are TTL. Therefore, supply a TTL-level signal at the EXT CLK SMB and onboard circuits convert the signal to differential ECL.

**What is the accuracy of the CLK10 signal?**

The CLK10 generated by the VXI-MXI-Express Series controller is  $\pm 100$  ppm per the VXI specification. To use a more accurate reference for CLK10, connect the signal to the controller through the EXT CLK SMB input on the front panel.





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# Technical Support and Professional Services

Visit the following sections of the award-winning National Instruments Web site at [ni.com](http://ni.com) for technical support and professional services:

- **Support**—Technical support resources at [ni.com/support](http://ni.com/support) include the following:
  - **Self-Help Technical Resources**—For answers and solutions, visit [ni.com/support](http://ni.com/support) for software drivers and updates, a searchable KnowledgeBase, product manuals, step-by-step troubleshooting wizards, thousands of example programs, tutorials, application notes, instrument drivers, and so on. Registered users also receive access to the NI Discussion Forums at [ni.com/forums](http://ni.com/forums). NI Applications Engineers make sure every question submitted online receives an answer.
  - **Standard Service Program Membership**—This program entitles members to direct access to NI Applications Engineers via phone and email for one-to-one technical support as well as exclusive access to on demand training modules via the Services Resource Center. NI offers complementary membership for a full year after purchase, after which you may renew to continue your benefits.

For information about other technical support options in your area, visit [ni.com/services](http://ni.com/services), or contact your local office at [ni.com/contact](http://ni.com/contact).
- **Training and Certification**—Visit [ni.com/training](http://ni.com/training) for self-paced training, eLearning virtual classrooms, interactive CDs, and Certification program information. You also can register for instructor-led, hands-on courses at locations around the world.
- **System Integration**—If you have time constraints, limited in-house technical resources, or other project challenges, National Instruments Alliance Partner members can help. To learn more, call your local NI office or visit [ni.com/alliance](http://ni.com/alliance).
- **Declaration of Conformity (DoC)**—A DoC is our claim of compliance with the Council of the European Communities using

the manufacturer's declaration of conformity. This system affords the user protection for electromagnetic compatibility (EMC) and product safety. You can obtain the DoC for your product by visiting [ni.com/certification](http://ni.com/certification).

If you searched [ni.com](http://ni.com) and could not find the answers you need, contact your local office or NI corporate headquarters. Phone numbers for our worldwide offices are listed at the front of this manual. You also can visit the Worldwide Offices section of [ni.com/niglobal](http://ni.com/niglobal) to access the branch office Web sites, which provide up-to-date contact information, support phone numbers, email addresses, and current events.

# Glossary

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Symbol	Prefix	Value
p	pico	$10^{-12}$
n	nano	$10^{-9}$
$\mu$	micro	$10^{-6}$
m	milli	$10^{-3}$
k	kilo	$10^3$
M	mega	$10^6$
G	giga	$10^9$
T	tera	$10^{12}$

## Symbols

° Degrees.

$\Omega$  Ohms.

## A

A Amperes.

address Character code that identifies a specific location (or series of locations) in memory. In VISA, it identifies a resource.

address modifier One of six signals in the VMEbus specification used by VMEbus masters to indicate the address space in which a data transfer is to take place.

address space A set of  $2^n$  memory locations differentiated from other such sets in VXI/VMEbus systems by six addressing lines known as address modifiers.  $n$  is the number of address lines required to uniquely specify a byte location in a given space. Valid numbers for  $n$  are 16, 24, 32, and 64. In VME/VXI, because there are six address modifiers, there are 64 possible address spaces.

ANSI	American National Standards Institute
API	Application Programming Interface—the direct interface that an end user sees when creating an application.
arbitration	A process in which a potential bus master gains control over a particular bus.
<b>B</b>	
B	Byte—eight related bits of data, an 8-bit binary number. Also used to denote the amount of memory required to store one byte of data.
backplane	An assembly, typically a printed circuit board, with 96-pin connectors and signal paths that bus the connector pins. A C-size VXIbus system will have two sets of bused connectors called J1 and J2. A D-size VXIbus system will have three sets of bused connectors called J1, J2, and J3.
BERR*	bus error signal
BIOS	Basic Input/Output System. BIOS functions are the fundamental level of any PC or compatible computer. BIOS functions embody the basic operations needed for successful use of the computer's hardware resources.
block-mode transfer	An uninterrupted transfer of data elements in which the master sources only the first address at the beginning of the cycle. The slave is then responsible for incrementing the address on subsequent transfers so that the next element is transferred to or from the proper storage location. A VME data transfer may have no more than 256 elements.
bus	The group of conductors that interconnect individual circuitry in a computer. Typically, a bus is the expansion vehicle to which I/O or other devices are connected. Examples of buses include the ISA bus, PCI bus, VXI bus, and VME bus.
bus error	An error that signals failed access to an address. Bus errors occur with low-level accesses to memory and usually involve hardware with bus mapping capabilities. For example, nonexistent memory, a nonexistent register, or an incorrect device access can cause a bus error.
bus master	A device that is capable of requesting the Data Transfer Bus (DTB) for the purpose of accessing a slave device.

byte order                      How bytes are arranged within a word or how words are arranged within a longword. Motorola ordering stores the most significant byte (MSB) or word first, followed by the least significant byte (LSB) or word. Intel ordering stores the LSB or word first, followed by the MSB or word.

## C

C                                      Celsius

CLK10                              A 10 MHz,  $\pm 100$  ppm, individually buffered (to each module slot), differential ECL system clock that is sourced from Slot 0 of a VXIbus mainframe and distributed to Slots 1 through 12 on P2. It is distributed to each slot as a single-source, single-destination signal with a matched delay of under 8 ns.

Commander                      A message-based device that is also a bus master and can control one or more Servants.

configuration registers        A set of registers through which the system can identify a module device type, model, manufacturer, address space, and memory requirements. To support automatic system and memory configuration, the VXI specification requires that all VXIbus devices have a set of such registers.

## D

Data Transfer Bus              DTB; one of four buses on the VMEbus backplane. The DTB is used by a bus master to transfer binary data between itself and a slave device.

DMA                                Direct Memory Access—a method by which data is transferred between devices and internal memory without intervention of the central processing unit. DMA is the fastest method of transferring data to/from computer memory.

DRAM                              Dynamic RAM (Random Access Memory)—storage that the computer must refresh at frequent intervals.

dynamic configuration        A method of automatically assigning logical addresses to VXIbus devices at system startup or other configuration times.

dynamically configured device      A device that has its logical address assigned by the Resource Manager. A VXI device initially responds at Logical Address 255 when its MODID line is asserted. The Resource Manager subsequently assigns it a new logical address, to which the device responds until powered down.

## E

ECL      Emitter-Coupled Logic

EEPROM      Electronically Erasable Programmable Read Only Memory—ROM that can be erased with an electrical signal and reprogrammed.

embedded controller      An intelligent CPU (controller) interface plugged directly into the VXI backplane, giving it direct access to the VXIbus. It must have all of its required VXI interface capabilities built in.

EMC      electromagnetic compliance

EMI      electromagnetic interference

external trigger      A voltage pulse from an external source that triggers an event.

## F

fair requester      A VXIbus device that will not arbitrate for the VXIbus after releasing it until it detects the bus request signal inactive. This ensures that all requesting devices will be granted use of the bus.

firmware      Software embedded in the VXI-MXI-Express Series controller, contained on EEPROM and flash memory that can be updated with a special utility (part of MAX). In combination with the hardware, the firmware enables the VXI-MXI-Express Series controller to act as a translator between USB and VXI protocols.

## G

g      (1) grams  
(2) a measure of acceleration equal to 9.8 m/s<sup>2</sup>

GPIO      General Purpose Interface Bus (IEEE 488)

$g_{\text{RMS}}$	A measure of random vibration. The root mean square of acceleration levels in a random vibration test profile.
<b>H</b>	
hex	Hexadecimal—the numbering system with base 16, using the digits 0 to 9 and letters A to F.
Hz	hertz; cycles per second
<b>I</b>	
I/O	Input/output—the techniques, media, and devices used to achieve communication between machines and users.
IEC	International Electrotechnical Commission. The IEC publishes internationally recognized standards. IEC 60068 contains information on environmental testing procedures and severities.
IEEE	Institute of Electrical and Electronics Engineers
in.	inches
instrument driver	A set of routines designed to control a specific instrument or family of instruments, and any necessary related files for LabWindows/CVI or LabVIEW.
interrupt	A means for a device to request service from another device; a computer signal indicating that the CPU should suspend its current task to service a designated activity.
interrupt handler	A VMEbus functional module that detects interrupt requests generated by interrupters and responds to those requests by requesting status and identify information.
interrupt level	The relative priority at which a device can interrupt.
IRQ*	interrupt signal

## K

**K** kilo—the prefix for 1,024, or  $2^{10}$ , used with B (byte) in quantifying data or computer memory.

**k** kilo—the standard metric prefix for 1,000, or  $10^3$ , used with units of measure such as volts, hertz, and meters.

## L

**logical address** An 8-bit number that uniquely identifies each VXIbus device in a system. It defines the A16 register address of a device, and indicates Commander and Servant relationships.

## M

**m** meters

**M** mega—(1) the standard metric prefix for 1 million or  $10^6$ , when used with units of measure such as volts and hertz; (2) the prefix for 1,048,576, or  $2^{20}$ , when used with B (byte) to quantify data or computer memory.

**master** A functional part of a VME/VXIbus device that initiates data transfers on the backplane. A transfer can be either a read or a write.

**message-based device** An intelligent device that implements the defined VXIbus registers and communication protocols. These devices are able to use Word Serial Protocol to communicate with one another through communication registers.

**MODID** Module ID lines—used in VXI to geographically locate boards and to dynamically configure boards.

**MTBF** Mean Time Between Failure

**MXI-3** A PCI Master/Slave system implementing the PCI-to-PCI Bridge register set. It couples two physically separate PCI buses with either a copper or fiber optic data link capable of 1.5 Gbits/s serial data rates.

**MXI-Express** An extension of MXI based upon PCI Express. MXI-Express provides bandwidth of up to 110 MB/s.



**N**

NI-488.2 or NI-488.2M	The National Instruments industry-standard software for controlling GPIB instruments.
NI-DAQ	The National Instruments industry-standard software for data acquisition instruments.
NI-VISA	The National Instruments implementation of the VISA standard; an interface-independent software that provides a unified programming interface for VXI, GPIB, and serial instruments.
NI-VXI	The National Instruments bus interface software for VME/VXIbus systems.
Non-Slot 0 device	A device configured for installation in any slot in a VXIbus mainframe other than Slot 0. Installing such a device into Slot 0 can damage the device, the VXIbus backplane, or both.

**P**

PCI	Peripheral Component Interconnect. The PCI bus is a high-performance 32-bit or 64-bit bus with multiplexed address and data lines.
PCI Express	A serialized, highly scalable I/O interconnect standard that leverages existing PCI technology such as the software model and the load-store architecture.

**R**

register-based device	A Servant-only device that supports VXIbus configuration registers. Register-based devices are typically controlled by message-based devices via device-dependent register reads and writes.
Resman	The name of the National Instruments Resource Manager in NI-VXI bus interface software. <i>See also</i> Resource Manager.
Resource Manager	A message-based Commander located at Logical Address 0, which provides configuration management services such as address map configuration, Commander and Servant mappings, and self-test and diagnostic management.

retry An acknowledge by a destination that signifies that the cycle did not complete and should be repeated.

RMS Root mean squared. *See also* [gRMS](#).

## S

s seconds

slave A functional part of a VME/VXIbus device that detects data transfer cycles initiated by a VMEbus master and responds to the transfers when the address specifies one of the device's registers.

Slot 0 device A device configured for installation in Slot 0 of a VXIbus mainframe. This device is unique in the VXIbus system in that it performs the VXI/VMEbus System Controller functions, including clock sourcing and arbitration for data transfers across the backplane. Installing such a device into any other slot can damage the device, the VXIbus backplane, or both.

SMB Sub Miniature Type B connector that features a snap coupling for fast connection.

statically configured device A device whose logical address cannot be set through software; that is, it is not dynamically configurable.

SYSFAIL A VMEbus signal that is used by a device to indicate an internal failure. A failed device asserts this line. In VXI, a device that fails also clears its PASSEd bit in its Status register.

## T

trigger Either TTL or ECL lines used for intermodule communication.

TTL Transistor-Transistor Logic

## U

USB Universal Serial Bus—a serial bus for connecting computers to keyboards, printers, and other peripheral devices.

**V**

V	volts
VIC	VXI Interactive Control program, a part of the NI-VXI bus interface software. Used to program VXI devices and develop and debug VXI application programs.
VISA	Virtual Instrument Software Architecture. This is the general name given to VISA and its associated architecture.
VISAIC	VISA Interactive Control program, a part of the NI-VISA software. Used to program devices and develop and debug application programs.
VITA	VMEbus International Trade Association
VME	Versa Module Eurocard or IEEE 1014
VMEbus System Controller	A device configured for installation in Slot 0 or a VXIbus mainframe or the first slot in a VMEbus chassis. This device is unique in the VMEbus system in that it performs the VMEbus System Controller functions, including clock sourcing and arbitration for data transfers across the backplane. Installing such a device into any other slot can damage the device, the VMEbus/VXIbus backplane, or both.
VXIbus	VMEbus Extensions for Instrumentation

**W**

W	watts
Word Serial Protocol	The simplest required communication protocol supported by message-based devices in a VXIbus system. It utilizes the A16 communication registers to transfer data using a simple polling handshake method.
write posting	A mechanism that signifies that a device will immediately give a successful acknowledge to a write transfer and place the transfer in a local buffer. The device can then independently complete the write cycle to the destination.

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